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SOUTHERN MARYLAND

By

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SOUTHERN MARYLAND

By C. Wythe Cooke

GENERAL FEATURES

The peninsula between Chesapeake Bay and the Potomac River, including Anne Arundel, Prince Georges, Charles, Calvert, and St. Marys Counties, is popularly known as southern Maryland. There are other parts of the State as far south as these counties, but they lie on the opposite side of Chesapeake Bay and are therefore called the Eastern Shore. A line connecting Baltimore and Washington marks the north end of southern Maryland.

Southern Maryland is primarily an agricultural region. Its mild and equable climate favors the growth of tomatoes, strawberries, other garden produce, and tobacco. The principal city is Annapolis (population 12,531 in 1930), the capital of Maryland.

GEOMORPHOLOGY

The cities of Washington and Baltimore lie at the junction of two geomorphic provinces—the Piedmont province, on the west, and the Coastal Plain, on the east. The Piedmont in this region is a rolling peneplaned upland which in few places exceeds 400 feet (122 meters) above sea level. By its ancient crystalline rocks the Piedmont is distinguished from the adjoining Coastal Plain, which is underlain by Cretaceous to Recent unmetamorphosed sediments. The irregular contact of the Piedmont and the Coastal Plain passes through the northwestern parts of Washington and Baltimore with a trend of about N. 40° E. Southern Maryland lies wholly within the Coastal Plain.

A conspicuous feature of the Coastal Plain in Maryland is the great system of inland waterways. Chesapeake Bay, which is the drowned valley of the Susquehanna River, is the largest. The Potomac River, also drowned, is navigable to Washington. Southern Maryland is penetrated by several tidal tributaries of these waterways. The Patuxent River, which rises in the Piedmont, flows almost the entire length of southern Maryland and splits the peninsula in two. Much of its course is tidal.

The valleys now occupied by Chesapeake Bay, the Potomac River, and probably also the Patuxent River appear to have been formed during late Tertiary time, when the land in that vicinity stood considerably higher than now. At the end of Pliocene time a tilting or warping of the continent submerged the Coastal

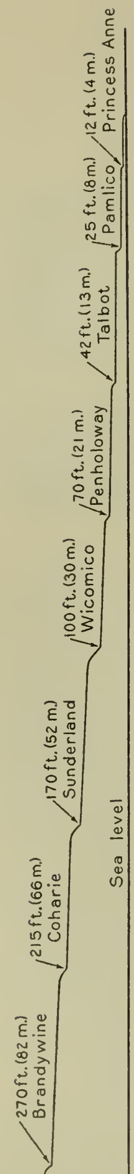

FIGURE 1.—Ideal arrangement of the Pleistocene coastal terraces

Plain of the Middle and North Atlantic States beneath the sea and slightly raised the Coastal Plain in the Southeastern States. The valleys in the north were deeply drowned well into the Piedmont, but the streams in the south extended their courses across the newly emerged part of the continental shelf. The mouths of even these southern streams are slightly drowned now, but this drowning is much more recent and seems to be due to a world-wide rise of sea level.

In spite of this late Pleistocene or Recent rise of sea level, the coast of Maryland is now much less deeply drowned than it was at the beginning of the Pleistocene, for the sea appears to have stood then about 270 feet (82 meters) higher than its present level. That it did so is indicated by a series of scarps, supposed to mark an ancient shore line, which bevel across the tilted Pliocene surface at that altitude.

Between the 270-foot shore line and the present beach there are seven other shore lines, also horizontal, which indicate successively lower stages of the sea. There is good evidence that the retreat of the sea from the highest level to the present did not take place by simple intermittent lowering from one level to the next but that it occurred by repeated oscillations from high to low and part way back. These fluctuations of sea level have been attributed to alternating accumulation and melting of the continental ice sheets during glacial and interglacial stages, but part of the lowering may have been due to crustal movements beneath distant oceans, for it is hardly likely that the existing ice caps contain enough water to raise the sea to its former height of 270 feet if they were to be completely melted.

Each of these shore lines marks the landward limit of a terrace.[1] As a terrace retains many of the irregularities which it had while it was the bottom of a sea or estuary and therefore varies in altitude from place to place, it is best defined by

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[1] By terrace is here meant the surface of the ground and not the bench that underlies the sedimentary deposits.

pointing out its former shore line, which marks a definite datum plane. The shore lines of the Pleistocene terraces of the eastern United States are horizontal and stand approximately at the following altitudes above present mean sea level, as shown diagrammatically in Figure 1:

Brandywine terrace, 270 feet (82 meters).
Coharie terrace, 215 feet (66 meters).
Sunderland terrace, 170 feet (52 meters).
Wicomico terrace, 100 feet (30 meters).
Penholoway terrace, 70 feet (21 meters).
Talbot terrace, 42 feet (13 meters).
Pamlico terrace, 25 feet (8 meters).
Princess Anne terrace, 12 feet (4 meters).

In southern Maryland the terraces below the Sunderland are entirely estuarine. They form comparatively narrow fringes along the shores of the Potomac, Patuxent, and Patapsco Rivers, Chesapeake Bay, and their tributaries. The Sunderland terrace originally occupied more than half of southern Maryland, but it is now greatly dissected. While it was being formed the seashore seems to have lain 10 or 12 miles (16 to 19 kilometers) west of the present shore of Chesapeake Bay (all of the land east of Chesapeake Bay was submerged), and the Potomac River from Washington to Charlotte Hall was a wide bay. The original extent of the terraces in southern Maryland and adjacent parts of Maryland, Virginia, and the District of Columbia is shown in Plate 1. The terraces are not now so extensive, for they have been deeply dissected along the edges and at some places have been completely destroyed, but many broad flat areas, such as that near Brandywine, still retain nearly their original shape.

The altitude of southern Maryland ranges from sea level to 300 feet (92 meters) above sea level. The local relief is greater than might be supposed, because the high land is nowhere far from tidewater. In parts of the Calvert Cliffs there is an almost sheer drop from an altitude of 160 feet (49 meters) on the Sunderland terrace to Chesapeake Bay.

STRUCTURE

The Coastal Plain, of which southern Maryland forms a part, has never been subjected to violent movements of the earth. The deposits of which it is composed retain very nearly their original position, although those older than the Pleistocene have been very gently tilted or warped. The regional dip is southeastward, toward the Atlantic Ocean. The dip rarely exceeds 40 feet to the mile (7.5 meters to the kilometer), and at most places in southern Maryland it is much less.

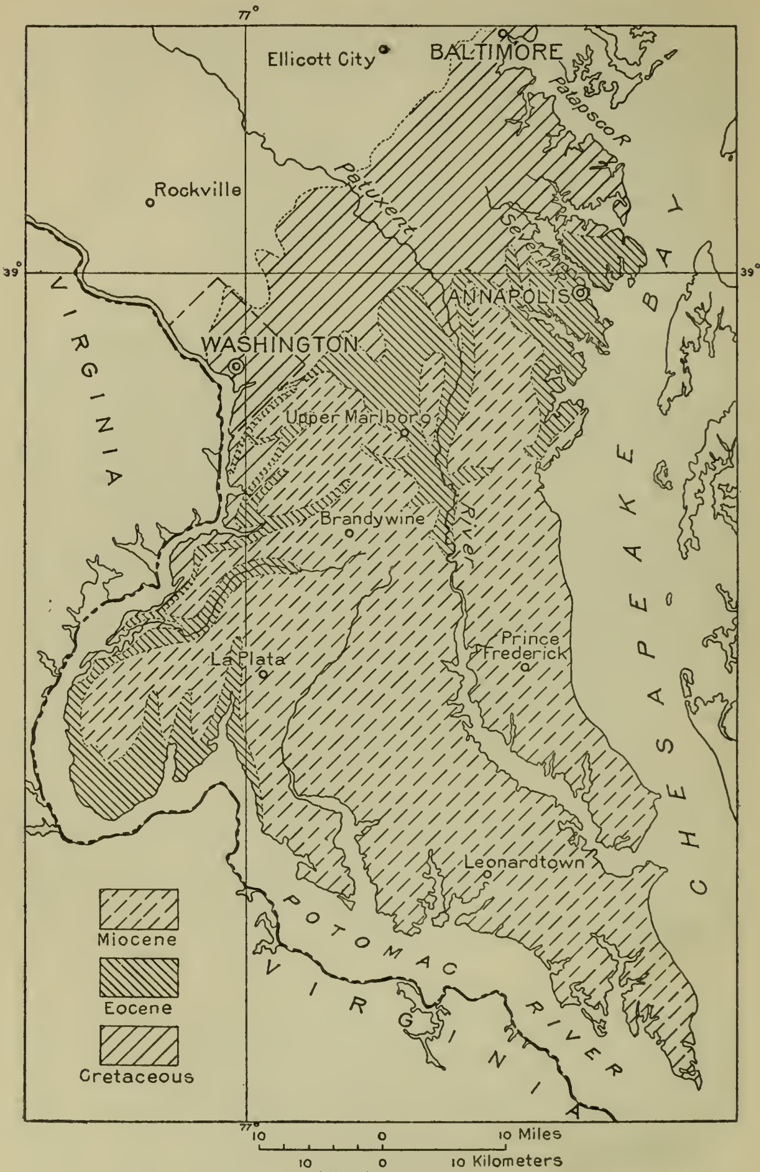
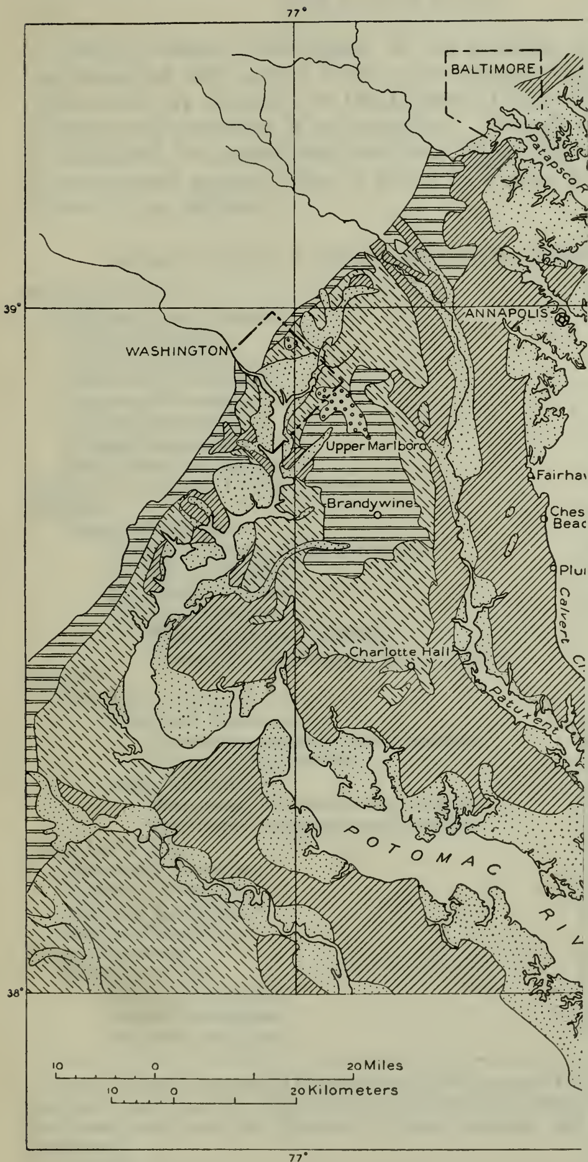


FIGURE 2.—Geologic sketch map of southern Maryland



SKETCH MAP OF THE TERRACES IN SOUTHE
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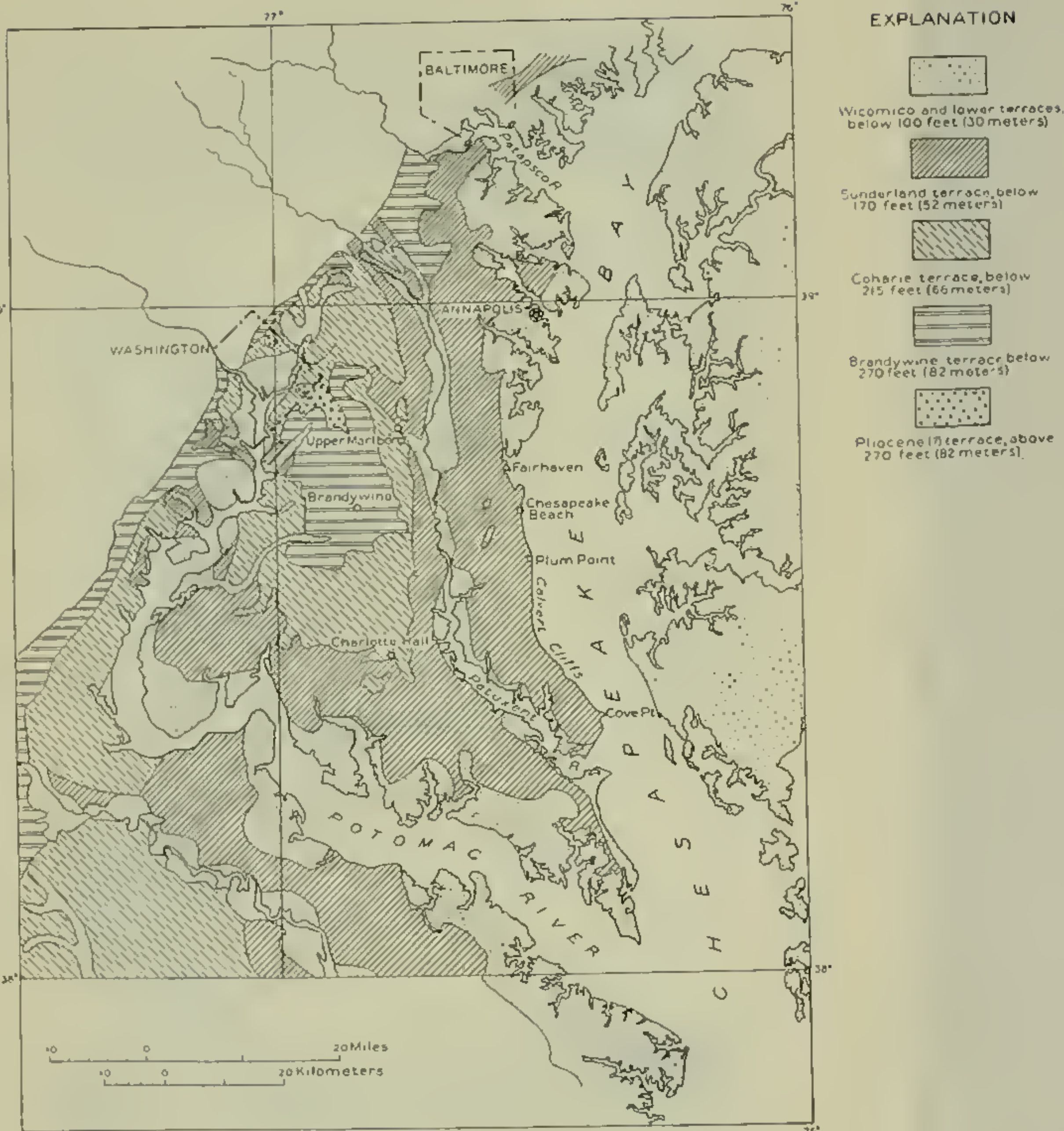
OF COLUMBIA



SKETCH MAP OF THE TERRACES IN SOUTHERN MARYLAND AND ADJACENT PARTS OF MARYLAND, VIRGINIA, AND THE DISTRICT OF COLUMBIA

STRATIGRAPHY

Geologic column.—Although all the geologic epochs since the beginning of the Lower Cretaceous except the Oligocene are represented by deposits in the Coastal Plain of Maryland and Virginia, the sequence is not complete. Nearly every formation is separated by unconformities from those above and below it. A generalized geologic map is given in Figure 2. The geologic column is as follows:

Geologic formations in southern Maryland and adjacent regions

- Pleistocene:[2]
  - Princess Anne formation.
  - Pamlico formation.
  - Talbot formation.
  - Penholoway formation.
  - Wicomico formation.
  - Sunderland formation.
  - Coharie formation.
  - Brandywine formation.
- Pliocene(?): Unnamed terrace gravels.
- Miocene:
  - Chesapeake group—
    - Yorktown formation (in Virginia).
    - St. Marys formation.
    - Choptank formation.
    - Calvert formation—
      - Plum Point marl member.
      - Fairhaven diatomaceous earth member.
- Eocene:
  - Pamunkey group—
    - Nanjemoy formation—
      - Woodstock greensand marl member.
      - Potapaco clay member.
    - Aquia formation—
      - Paspotansa greensand marl member.
      - Piscataway indurated marl member.
- Upper Cretaceous:
  - Monmouth formation.
  - Matawan formation.
  - Magothy formation.
  - Raritan formation.
- Lower Cretaceous:
  - Potomac group—
    - Patapsco formation.
    - Arundel formation.
    - Patuxent formation.

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[2] Part of what is here called Coharie and all the younger Pleistocene formations constitute the Columbia group of earlier authors; the remainder of the Coharie, the Brandywine, and the Pliocene (?) were formerly called the "Lafayette formation."

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Lower Cretaceous.—The Lower Cretaceous epoch is represented in Maryland and Virginia by the Potomac group, which consists of three formations. The Patuxent formation, at the base of the group, consists of light-colored arkosic sand, clay lenses, and gravel layers. It is overlain unconformably by the Arundel formation, which generally consists chiefly of fine sand but near Washington is represented by drab, red, and black clay carrying lignite and iron ores. Unconformably above the Arundel is the Patapsco formation, which consists chiefly of variegated clay interbedded with sand and gravel.

The Patuxent formation, because of its coarse texture, is generally unfossiliferous, but fossil ferns, cycads, and gymnosperms have been found in it in Virginia. The Arundel formation contains a good many dinosaurs, a few crocodiles, turtles, and fresh-water mollusks, and a flora similar to that of the Patuxent. The Patapsco formation has yielded a few poorly preserved unios and an extensive flora which differs from that of the Patuxent in that it includes an abundance of dicotyledons.

Upper Cretaceous.—The Upper Cretaceous deposits of Maryland are divided into four formations—the Raritan at the base, the Magothy, the Matawan, and the Monmouth. The Raritan, which lies unconformably on the Patapsco formation, consists chiefly of sand and clay that are generally light-colored but tend to become stained and indurated by iron oxide at the base. The Magothy also consists chiefly of light-colored sand, but it includes dark-colored lignitic clay that contains scattered lumps of amber. The Matawan formation consists largely of dark-colored micaceous, sandy, somewhat glauconitic clay. Its beds are much more persistent than those of the Raritan and Magothy. The Monmouth formation consists chiefly of reddish and pinkish sand which generally contains more glauconite than the Matawan.

The Raritan deposits have yielded a few bones of plesiosaurs, a few doubtfully brackish-water mollusks, and a variety of plants. According to E. W. Berry (2)[3] it is of Cenomanian age. The Magothy formation contains a few mud-loving estuarine mollusks and a larger fossil flora; it is correlated with the lower Senonian (Coniacian or lower Dantonian) of Europe.[4] The fauna of the Matawan formation is entirely marine. It includes echinoderms, crustaceans, mollusks, bryozoans, and fish. It, too, is placed in the lower Senonian (upper Santonian and lower Campanian). The Monmouth formation carries a large shallow-water marine

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[3] Numbers in parenthese refer to bibliography, p. 16.

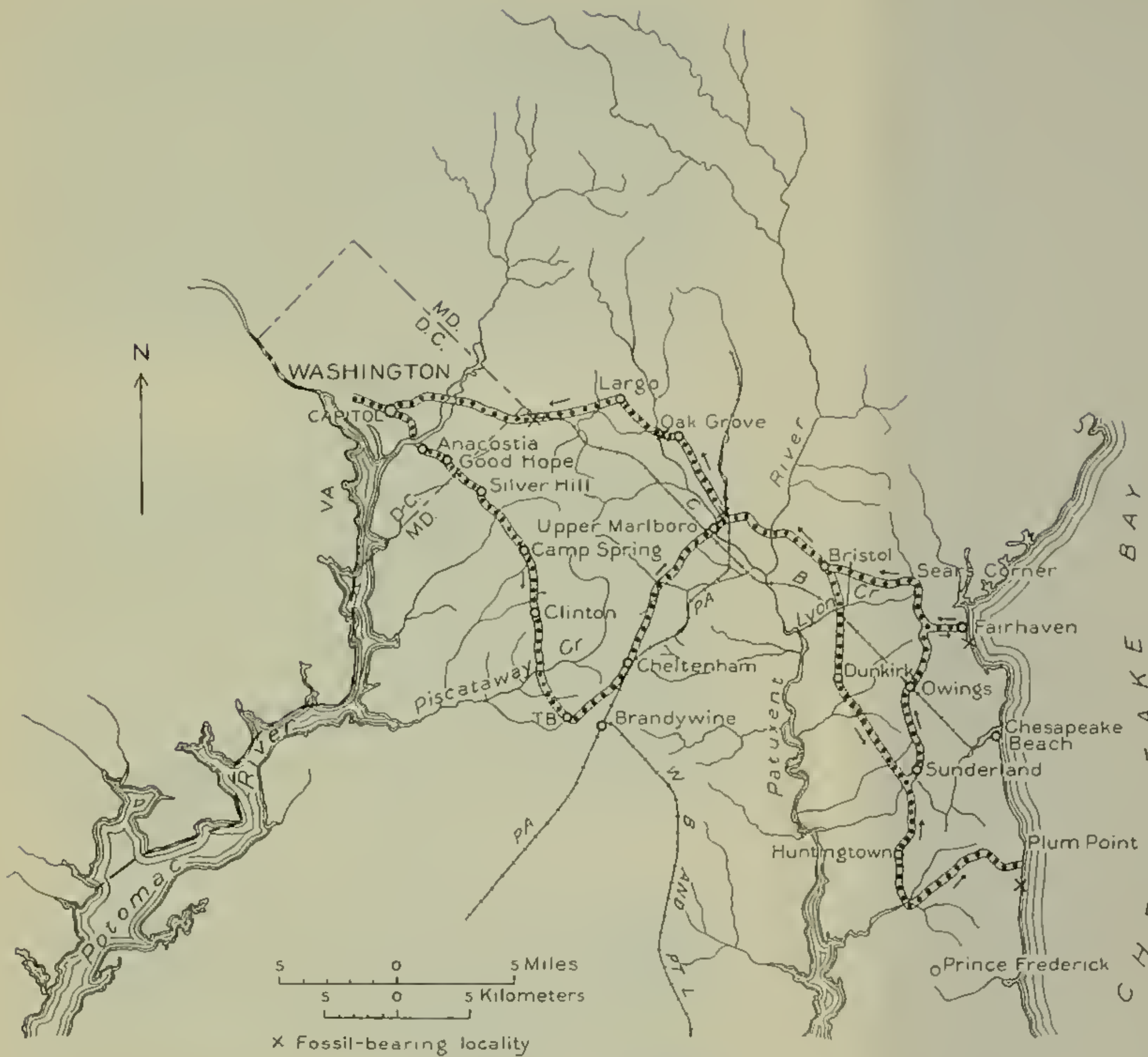
[4] The correlations of the Magothy, Matawan, and Monmouth formations are based on the conclusions of Julia Gardner (2) and L. W. Stephenson (15).

fauna which points to the upper Senonian (upper Campanian or Maestrichtian) age of the beds.

Eocene.—The Eocene deposits of Maryland are divided into the Aquia formation, at the base, and the Nanjemoy, above. Each of these formations is subdivided into two members. The entire series is marine. The Aquia formation, about 100 feet (30 meters) thick, consists chiefly of glauconite and glauconitic marl. It includes several thin ledges of marlstone or impure limestone. One of the most conspicuous fossils in the Aquia is *Turritella mortoni*, which indicates that the formation is equivalent to part of the Wilcox group of Alabama. The Nanjemoy formation also contains much glauconite, but it is ordinarily more argillaceous and less calcareous than the Aquia. It is about 125 feet (38 meters) thick. The presence of *Ostrea sellaeformis* and other fossils indicates that part of the Nanjemoy is equivalent to the Lisbon formation of the Claiborne group.

Miocene.—The Miocene deposits of Maryland and Virginia, called Chesapeake group, are divided into four formations—the Calvert, Choptank, St. Marys, and Yorktown formations—of which the Yorktown does not occur in Maryland. They can be easily distinguished from the Eocene formations because they contain little glauconite. All are marine.

The Calvert formation, which lies at the base of the Miocene, falls into two divisions—a lower, called Fairhaven diatomaceous earth member, and an upper, the Plum Point marl member. The Fairhaven member consists of a basal 6-foot (1.8-meter) bed of brownish sand overlain by a thin stratum of highly fossiliferous white sand, which in turn is overlain by about 55 feet (17 meters) of very fine grained greenish diatomaceous earth that bleaches white or buff. More than half of this bed is composed of diatoms. The Plum Point marl member consists of bluish-green, grayish-brown, or buff sandy clay and marl containing many organic remains, including diatoms. The lowest bed (zone 4) is a 6-inch (15-centimeter) deposit of greenish sandy clay containing many shells of *Ostrea percrassa*. It is exposed at Chesapeake Beach and southward along the beach for a distance of about 2½ miles (4 kilometers). Fossil shells are most abundant and best preserved in a 6 to 9 foot (1.8 to 2.7 meter) bed (zone 10) of grayish-green to yellow or brown sandy clay which is exposed continuously along the cliffs south of Chesapeake Beach until it passes below sea level 2 or 3 miles (about 4 kilometers) beyond Plum Point Wharf. This bed contains *Turritella indentata*, *Phacoides anodonta*, *Crassatellites melinus*, *Astarte cuneiformis*, *Ostrea sellaeformis*, *Pecten madisonius*, *Macrocallista marylandica*, *Atrina harrisii*, *Arca subrostrata*, *Glycimeris parilis*, etc.



ITINERARY OF EXCURSION B-7

Dotted line shows route of excursion.

According to the interpretation accepted by the writer [5] all eight of the Pleistocene terraces record high stages of tidal waters, and the corresponding geologic formations are therefore estuarine or marine. The typical Brandywine appears to have been deposited along the open seashore. Most of the coarser material in this and the succeeding formations was derived from the Pliocene(?) gravel near by and resembles it in composition. As the sea retreated to lower levels, more and more of the ancient drowned valleys of the Potomac River and Chesapeake Bay emerged above tide, and the estuaries in which the lower Pleistocene formations were deposited became successively smaller. Some of the sediment that accumulated in the lower parts of the drowned valleys during each high-water interglacial stage was scoured away by the rejuvenated rivers when the valleys were temporarily drained during each low-water glacial stage.

ITINERARY

GENERAL FEATURES

The following annotated road logs show the itinerary for a 1-day excursion from Washington into southern Maryland and return. The route is marked on Plate 2. The distance for the round trip is 114 miles (183 kilometers). The excursion should be of particular interest to students of Tertiary fossils, for it includes visits to the famous Calvert Cliffs, which contain beautifully preserved Miocene shells, and to the well-known but less prolific exposures of Eocene beds at Upper Marlboro. Miocene diatoms can be collected at Plum Point and at Fairhaven. Both Upper and Lower Cretaceous deposits are crossed along the route. Much of the route lies upon Pliocene(?) and Pleistocene gravel. Geomorphologists will find of interest the visit to the type area of the Brandywine terrace and to Sunderland, from which another terrace was named, and they will have an opportunity to examine the abandoned shore line of a Pamlico estuary.

WASHINGTON TO UPPER MARLBORO BY WAY OF BRANDYWINE

Department of the Interior, F Street between Eighteenth and Nineteenth Streets, Washington. The Interior Building stands on the outer edge of the Penholoway terrace; the entrance on F Street, at an altitude of about 60 feet (18 meters) above sea level, is a little lower than the natural

[5] Some geologists, notably M. R. Campbell (1) and C. K. Wentworth (16), do not recognize any marine terraces above the 100-foot (30-meter) Wicomico.

surface of the Penholoway terrace, and the entrance on E Street, one story lower, overlooks the Talbot terrace, which here is about 40 feet (12 meters) above sea level.

The route passes the State Department, the White House (the residence of the President), and the Treasury and continues down Pennsylvania Avenue to the Peace Monument.

1.9 (3).[6] Peace Monument, commemorating the end of the Civil War in 1865. Turn right and encircle the grounds of the Capitol. The flat summit of Capitol Hill, about 90 feet (27 meters) above sea level, is part of the Wicomico terrace. At the Library of Congress reenter Pennsylvania Avenue and follow it (still on the Wicomico terrace) to Eleventh Street SE.

3.4 (5.5). Eleventh Street. Turn south.

4.1 (6.6). Anacostia River, a broad tidal stream. From the bridge the Navy Yard can be seen on the right. Cross the reclaimed tidal marshes of Anacostia Park.

4.5 (7.2). Anacostia. Turn southeastward on Good Hope Road. On the hill approaching Good Hope are exposures of fine gray sand, containing a meager fauna of mollusks and plant-bearing clay (Upper Cretaceous Magothy formation), fine gray flaky clay (Miocene Calvert formation) and, at top, coarse Pliocene (?) gravel.

5.8 (9.3). Good Hope (altitude 280 feet, or 85 meters. Turn right and then left at forks of Naylor Road and Hamilton Road. Pliocene (?) gravel on gray Miocene (Calvert formation) clay is exposed on descent. From Good Hope to Camp Springs the route is chiefly on the eroded surface of a Pliocene (?) terrace.

6.5 (10.5). District of Columbia-Maryland line. One of the original boundary stones stands within an iron fence on the right.

6.6 (10.6). Cross Oxon Run (altitude 140 feet, or 43 meters); rise to rolling upland underlain by Pliocene (?) gravel.

7.9 (12.7). Silver Hill. Turn right.

8.5 (13.7). Gordons Corner. Turn southeastward on Brandywine Road.

9.3 (15). Henson Creek.

11.3 (18.2). Camp Springs (altitude 266 feet, or 81 meters). Leave the Pliocene (?) upland and enter the Pleistocene Brandywine terrace. The gravel exposed 0.3 mile (0.5 kilometer) beyond Camp Springs is probably the Brandywine formation.

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[6] Figures indicate distance from starting point in miles, with kilometers in parentheses.

14.1 (22.7). Clinton (altitude 244 feet, or 74 meters). About 2 miles (3.2 kilometers) beyond Clinton the road descends from the Brandywine terrace to a reentrant of the Sunderland terrace that extends up Piscataway Creek.

16.7 (26.9). Piscataway Creek. The Piscataway member of the Eocene Aquia formation is named from this creek. The typical exposures are farther downstream. The fine gray sand exposed along the roadside south of the creek is the upper Eocene Nanjemoy formation. The contact of the Nanjemoy and the Pleistocene Sunderland gravel is exposed on the west side of the road opposite an electric transformer station 0.4 mile (0.6 kilometer) south of the creek. A short distance beyond this place the road rises to a reentrant of the Coharie terrace, which also is underlain by gravel, and continues on it most of the way to the village of T. B.

19.1 (30.7). T. B.

19.5 (31.4). Crossroad. Turn left (northeast) on Crain Highway. The village of Brandywine (altitude 233 feet, or 71 meters), from which the Brandywine terrace and formation receive their names, is 1.2 miles (1.9 kilometers) east of this crossroad. It is visible in the distance from the Crain Highway, which passes over the typical Brandywine terrace between this point and Cheltenham. Several cuts along the highway expose the gravel of the Brandywine formation.

20.9 (33.6). Cheltenham (altitude 237 feet, or 72 meters). Between Cheltenham and Upper Marlboro the land is considerably dissected. Many road cuts expose Pleistocene gravel and Miocene fine sand (Calvert formation).

24.6 (39.6). Rosaryville.

26.6 (42.8). Charles Branch. The fine dark-green glauconitic sand containing casts of shells is the Eocene Nanjemoy formation. The gravel pit at the top of the hill north of the creek is in the Pleistocene Wicomico formation.

30.2 (48.6). Upper Marlboro, the county seat of Prince Georges County.

UPPER MARLBORO TO PLUM POINT

Bridge over Western Branch at Upper Marlboro. Go east.

0.9 (1.4). Ascend hill with exposures of Eocene (Nanjemoy), Miocene (Calvert), and Pleistocene (Sunderland).

1.1 (1.8). Wells Corner. Turn southeast.

2.4 (3.9). Hills Bridge, Patuxent River. The river forms the boundary between Prince Georges County, on the west, and Anne Arundel County, on the east. The wide tidal flats on the east side constitute a Recent terrace in process of formation.

2.7 (4.3). Shore line of the Recent terrace. Begin rise to the Pamlico terrace.

2.9 (4.7). Shore line of the Pamlico terrace, about 25 feet (8 meters) above sea level. The coarse sand and gravel of the Pamlico beach lie against the finer glauconitic sand (Eocene, Nanjemoy formation or derived from it) in the scarp.

3 (4.8). Fork. Turn right (southeast) on Southern Maryland Boulevard. This higher terrace is probably the Penholoway.

3.7 (6). Plummers Branch.

3.8 (6.1). Road crossing. The green glauconitic sand is Eocene (Nanjemoy).

5.2 (8.4). Bristol. A capping of Pleistocene (Sunderland) gravel on Miocene (Calvert) sand.

7.3 (11.7). Lyons Creek. The road passes under the Chesapeake Beach Railway. The creek here forms the boundary between Anne Arundel County and Calvert County. Diatomaceous earth of the Miocene (Calvert) is mined near the mouth of the creek. The valley is cut through the Calvert formation into the Eocene Nanjemoy formation.

10.4 (16.7). Dunkirk.

11.2 (18). The deep cut near Hall Creek exposes the Calvert formation.

11.8 (19). T road leads east to Chesapeake Beach; continue south.

15.5 (24.9). Crossroads at All Saints Church.

18.9 (30.4). Huntingtown.

21.3 (34.3). Hunting Creek.

21.5 (34.6). Turn northeast on road to Plum Point. For most of the next 5 miles (8 kilometers) the road leads over Pleistocene gravel.

27.7 (44.6). Plum Point Wharf.

MIOCENE DEPOSITS AT PLUM POINT

The classical exposures of the Miocene of Maryland occur in the Calvert Cliffs, which extend with few interruptions along Chesapeake Bay from Chesapeake Beach to Drum Point, a distance of about 30 miles (48 kilometers). As the cliffs cut

diagonally across the strike, which is northeastward, the lowest beds are exposed at the north end and the highest at the south end, but the slope is very gradual. The cliffs near Plum Point expose the Calvert formation, the lowest of the three Miocene formations in Maryland.

Shattuck (5) divides the Calvert formation into 15 beds or zones and designates them by serial numbers, beginning with zone 1 at the bottom. He calls zones 1 to 3 the Fairhaven diatomaceous earth, and zones 4 to 15 the Plum Point marls. The Plum Point marl member is exposed in the cliffs from Chesapeake Beach, 6 miles (9.6 kilometers) north of Plum Point Wharf, to Governor Run, about 8 miles (12.9 kilometers) south of Plum Point Wharf. Shattuck gives the following section:

Section 1 mile [1.6 kilometers] south of Plum Point Wharf

	Feet	Meters
Miocene (Calvert formation):		
Fossiliferous yellowish sandy clay grading into yellow sand in its lower portions (zone 15)	48.5	14.8
Brownish sandy clay containing *Isocardia fraterna* (zone 14)	7.0	2.1
Bluish clay breaking with conchoidal fracture (zone 13)	13.5	4.1
Brownish sandy clay carrying imperfect fossil casts (zone 12)	2.5	.8
Unfossiliferous bluish clay (zone 11)	11.0	3.4
Greenish sand bearing characteristic fossils (zone 10)	9.0	2.7
	91.5	27.9

Fossil mollusks are most numerous and best preserved in zone 10, which lies at the base of the bluff. Some of the species in it are listed on page 7. Zone 13 contains fossil diatoms.

PLUM POINT TO FAIRHAVEN

Plum Point. Return on same road as far as All Saints Church.

6.2 (10). Solomons Road. Turn north.

8.8 (14.2). Huntingtown.

12.2 (19.6). All Saints Church. Take right fork (Maryland State Highway No. 2).

12.9 (20.8). Sunderland. The Sunderland formation is named from this place, but the terrace here is much dissected. The shore line of the terrace is preserved near Charlotte Hall. (See pl. 1.)

15.1 (24.3). Mount Harmony.

16.7 (26.9). Owings. Cross Chesapeake Beach Railway.

17 (27.4). Calvert-Anne Arundel County line.

18.3 (29.5). Friendship.
19.7 (31.7). Fairhaven Road. Go east.
21.3 (34.3). Fork. Turn right.
22 (35.4). Fairhaven, on Chesapeake Bay.

MIOCENE DIATOMACEOUS CLAY AT FAIRHAVEN

The Fairhaven diatomaceous member of the Miocene Calvert formation is named from this place. The typical exposures are in the cliffs south of the inlet. The following section is quoted from Shattuck (5):

Section at Fairhaven, half a mile (0.8 kilometer) south of wharf

	Feet	Meters
Pleistocene: Gravel, sand and clay	10	3
Miocene (Calvert formation):		
Diatomaceous sandy clay bleached to a whitish color, jointed so as to have a rough columnar appearance, carrying *Phacoides contractus* (zone 3, in part)	24	7.3
Diatomaceous greenish sandy clay breaking with conchoidal fracture, carrying *Phacoides contractus* and bearing rolled and reworked fossils from Eocene in lower 2½ feet (0.75 meter) (zone 3, in part)	36	11
	70	21.3

FAIRHAVEN TO UPPER MARLBORO

2.3 (3.7). Solomons Road. Turn north.
4.8 (7.7). Sears Corner. Turn west.
8.9 (14.3). Bristol.
11.7 (18.8). Hills Bridge, Patuxent River.
13.1 (21). Fork. Turn west.
14 (22.5). Pennsylvania Railroad. Turn right on road to Bladensburg.
14.1 (22.7). Collington Branch at Upper Marlboro.

EOCENE FORMATIONS AT UPPER MARLBORO

The Eocene formations crop out in the fork between Western Branch and Collington Branch at Upper Marlboro. The upper beds of the following section are best exposed along the highway to Bladensburg. The lower beds crop out along a narrow road that leads eastward along the foot of the hill to the Pennsylvania Railroad. The section is adapted from Clark and Martin (4).

Section at Upper Marlboro

	Feet	Meters
Eocene:		
Nanjemoy formation—		
Glauconitic clay	22	6.7
Pink clay, without glauconite or fossils	22	6.7
Aquia formation (Paspotansa member)—		
Coarse glauconitic sand	32	9.8
Shell marl with *Gibbula glandula, Fissuridea marlboroensis, Lucina aquiana, Diplodonta marlboroensis, Venericardia planicosta* var. *regia, Pteria limula, Cucullaea gigantea, Leda parilis, Nucula ovula*	2	.6
Indurated ledge with *Turritella mortoni, T. humerosa, Mesalia obruta, Calyptraphorus jacksoni, Panopea elongata, Meretrix ovata* var. *pyga, Dosiniopsis lenticularis, Venericardia planicosta* var. *regia, Crassatellites alaeformis, Astarte marylandica, Glycymeris idoneus, Cucullaea gigantea, Leda parilis, Nucula ovula*	5	1.5
Glauconitic sand (known as bryozoan sand) full of fine fragments of shells accompanied by Bryozoa, echinoid spines, and Foraminifera; and with *Ostrea compressirostra, Gryphaeostrea vomer,* and *Platidia marylandica*	5	1.5
	88	26.8

According to R. S. Bassler, the bryozoan fauna of the Aquia formation at Upper Marlboro and that of the Vincentown sand of New Jersey are very similar to the fauna of the Danian of Europe.

UPPER MARLBORO TO WASHINGTON BY WAY OF CENTRAL AVENUE

Collington Branch at Upper Marlboro. Go northwest on road to Bladensburg.

4.4 (7.1). Fork at Oak Grove. The plain is a remnant of the Sunderland terrace.

5.1 (8.2). Exposure of Eocene beds in road cut. This is probably the place "3 miles [4.8 kilometers] west of Leeland" from which fossils are listed by Clark and Martin (4).

Section east of Western Branch 0.7 mile (1.1 kilometers) west of Oak Grove

	Feet	Meters
Eocene (Aquia formation):		
Much oxidized glauconitic sand containing casts of mollusks	15	4.6
Irregularly indurated glauconitic marl containing many shells. *Ostrea compressirostra* is the most conspicuous species	7	2.1
Rusty glauconitic sand	3	.9
Covered to water level in Western Branch	16	4.9

5.1 (8.2). Western Branch. The stream flows on the Penholoway terrace.

5.6 (9). Rise to a higher terrace, probably the Wicomico.

7.6 (12.2). Largo. Turn left on Central Avenue.

8.2 (13.2). Terrace, probably the bed of an old estuary, on the left.

9.4 (15.1). Ritchie.

10.9 (17.5). Seat Pleasant.

11.4 (18.3). Bridge over Chesapeake Railway. The railroad cut exposes very dark green or gray micaceous sand (Upper Cretaceous Monmouth formation), containing *Exogyra costata* and casts of other mollusks. Seventeen species of fossils are listed from this place.

12.5 (20.1). District of Columbia-Maryland line. The red sand and clay is the Lower Cretaceous Patapsco formation.

13.6 (21.9). Benning Road.

14.4 (23.2). Benning Viaduct. The plain is the Talbot terrace.

15 (24.1). Anacostia River. The flats are reclaimed tidal marshes.

16.1 (25.9). Fifteenth and H Streets NE. Turn left into Maryland Avenue. Rise gradually to the Wicomico terrace at Twelfth and F Streets and continue on it to the Capitol.

18 (29). Peace Monument.

19.8 (31.9). Interior Department.

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